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Title:

INTEGRATION OF GaAs ON Si USING A SPINEL BUFFER LAYER

Text

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A method is proposed of producing single-crystal GaAs layers on a single- crystal Si substrate material using a spinel buffer layer to compensate for the different lattice constants of GaAs and Si. Because of their much higher electron mobility than standard Si material, GaAs or GaAlAs semiconductors may play a prominent role in future chip technology. However, in contrast to Si material, the difficulties of growing high quality, i.e., homogeneous, single-crystal GaAs bulk material have prevented the latter from being used as a chip material on a large scale. On the other hand, Molecular Beam Epitaxy (MBE) and Metal Organic Vapor Phase Epitaxy (MOVPE) have proved successful in the production of thin high-quality GaAs layers. Generally, it is a very attractive idea to use standard Si wafer material as a substrate to epitaxially grow another semiconductor. But the lattice constant of many semiconductors does not fit that of Si. Several techniques for compensating for such misfit are known from the literature; for example, a temperature gradient is used during layer growth, or one or more buffer layers of selected materials are initially grown on the Si substrate. A method of using special compounds from the group of spinels as a buffer layer is described below. Initially, the spinel MgAl2O4 is grown on the Si substrate. Then, an underlying amorphous oxide layer is produced by reoxidation. Some atoms of Mg and Al are substituted by atoms increasing the lattice constant of the spinel on the amorphous SiO2 layer, with this layer eliminating strain from the underlying Si wafer. Atom substitution can be simplified by using Li0.5Al2Fe0.5O4 with the lattice constant a = 0.8083 nm and by subsequently replacing the Al by Fe, obtaining Li0.5Fe2.5O4 (a = 0.835 nm). By adding Zn, the lattice constant can be adjusted still further to a = 0.84135 nm, which directly corresponds to GaAs, yielding the formula Li0.2Zn0.6Fe2.2O4 . Subsequently, the GaAs epitaxial layer is grown on the spinel.

Diagrams: none

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